Other university B.E./B.Tech - G
MECH Level 2 syllabus

Solid Mechanics

202041 - Solid Mechanics

Credits 05

Unit I Simple stresses & strains
Simple Stress & Strain: Introduction to types of loads (Static, Dynamic & Impact Loading) and
various types of stresses with applications, Hooke's law, Poisson's ratio, Modulus of Elasticity,
Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram
for ductile and brittle materials, factor of safety, Stresses and strains in determinate and
indeterminate beam, homogeneous and composite bars under concentrated loads and self-weight,
Thermal stresses in plain and composite members

Unit II Shear Force & Bending Moment Diagrams
SFD & BMD: Introduction to SFD, BMD with application, SFD & BMD for statically determinate
beam due to concentrated load, uniformly distributed load, uniformly varying load, couple and
combined loading, Relationship between rate of loading, shear force and bending moment, Concept
of zero shear force, Maximum bending moment, point of contra-flexure

Unit III Stresses, Slope & Deflection on Beams
Bending Stress on a Beam: Introduction to bending stress on a beam with application, Theory of
Simple bending, assumptions in pure bending, derivation of flexural formula, Moment of inertia of
common cross section (Circular, Hollow circular, Rectangular, I & T),

Bending stress distribution
along the same cross-section

Shear Stress on a Beam: Introduction to transverse shear stress on a beam with application, shear
stress distribution diagram along the Circular, Hollow circular, Rectangular, I & T cross-section

Slope & Deflection on a Beam: Introduction to slope & deflection on a beam with application,
slope, deflection and Radius of Curvature, Macaulay's Method, Slope and Deflection for all standard
beams

Unit IV Torsion, Buckling

Torsion of circular shafts: Introduction to torsion on a shaft with application, Basic torsion
formulae and assumption in torsion theory, Torsion in stepped and composite shafts, Torque
transmission on strength and rigidity basis, Torsional Resilience

Torsion on Thin-Walled Tubes: Introduction of Torsion on Thin-Walled Tubes Shaft and its
application

Buckling of columns: Introduction to buckling of column with its application, Different column
conditions and critical, safe load determination by Euler's theory. Limitations of Euler's Theory

Unit V Principal Stresses, Theories of Failure

Principal Stresses: Introduction to principal stresses with application, Transformation of Plane
Stress, Principal Stresses and planes (Analytical method and Mohr's Circle), Stresses due to
combined Normal and Shear stresses

Theories of Elastic failure: Introduction to theories of failure with application, Maximum principal
stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal
strain theory, Maximum strain energy theory

Unit VI Application based combined loading & stresses

(Based on load and stress condition studied in Unit I to Unit V)
Introduction to the Combined Loading and various stresses with application, Free Body Diagram and
condition of Equilibrium for determining internal reaction forces,

couples for 2-D system, Combined
stresses at any cross-section or at any particular point for Industrial and Real life example for the
following cases: Combined problem of Normal type of Stresses (Tensile, Compressive and Bending
stress), Combined problem of Shear type of stresses (Direct and Torsional Shear stresses), Combined
problem of Normal and Shear type of Stresses

Books & Other Resources

Text Books

1. R. K. Bansal, “Strength of Materials”, Laxmi Publication
2. S. Ramamurtham, “Strength of material”, Dhanpat Rai Publication
3. S.S. Rattan, “Strength of Material”, Tata McGraw Hill Publication Co. Ltd.
4. B.K. Sarkar, “Strength of Material”, McGraw Hill New Delhi
5. Singer and Pytel, “Strength of materials”, Harper and row Publication
6. R. C. Hibbeler, “Mechanics of Materials”, Prentice Hall Publication

Reference Books

1. Egor. P. Popov, “Introduction to Mechanics of Solids”,Prentice Hall Publication
2. G. H. Ryder, “Strength of Materials”, Macmillan Publication
3. Beer and Johnston, “Strength of materials”, CBS Publication
4. James M. Gere, “Mechanics of Materials”, CL Engineering
5. Timoshenko and Young, “Strength of Materials”, CBS Publication, Singapore
6. Prof. S.K. Bhattacharyya, IIT Kharagpur , “NPTEL Web course material”
https://drive.google.com/file/d/1N2Eyv9ofPimIT2OSMZeMrSxe68Ulclei usp=sharing

Solid Modeling and Drafting

202042 - Solid Modeling and Drafting

Credits 04

Unit I Fundamentals of 3D Modeling

Introduction, Product Life Cycle, CAD tools in the design process of Product Cycle, Scope of CAD,
Software Modules - Operating System (OS) module, Geometric module, application module,

programming module, communication module, Computer Aided Design - Features, requirements and
applications
3D Modeling approach - Primitive, Features and Sketching, Types of Geometric models - 21⁄2
extrusions, axisymmetric, composite, 3D objects, difference between wireframe, surface & solid
modeling, Modeling strategies
Model viewing: VRML web-based viewing

Unit II Curves & Surfaces
Curves: Methods of defining Point, Line and Circle, Curve representation - Cartesian and Parametric
space, Analytical and Synthetic curves, Parametric equation of line, circle, ellipse, Continuity (C0, C1 & C2), Synthetic Curves - Hermit Cubic Spline, Bezier, B-Spline Curve, Non-Uniform Rational B-Spline curves (NURBS)

Surfaces: Surface representation, Types of Surfaces, Bezier, B-Spline, NURBS Surface, Coons
patch surface, Surface Modeling
Reverse Engineering: Introduction, Point Cloud Data (PCD), PCD file formats, Quality issues in
PCD, Requirements for conversion of surface models into solid models, Applications of PCD

Unit III Solid Modeling
Introduction, Geometry and Topology, Solid entities, Solid representation, Fundamentals of Solid
modeling, Half spaces, Boundary representation (B-Rep), Constructive Solid Geometry (CSG),
Sweep representation, Analytical solid modeling, Parametric solid modeling, feature based modeling, etc., Euler Equation (Validity of 3D solids), Mass Property Calculations
Introduction to Assembly Modeling, Assemblies (Top-down and Bottom-up approach), Design for
Manufacturing [DFM], Design for Easy Assembly & Disassembly [DFA], Design for Safety

Unit IV Geometric Transformation
Introduction, Geometric Transformations, Translation, Scaling, Rotation, Reflection/Mirror, Shear,
Homogeneous Transformation, Inverse Transformation, Concatenated Transformation (limited to 2D

objects with maximum 3 points only), Coordinate systems - Model (MCS), Working (WCS), Screen
(SCS) coordinate system, Mapping of coordinate systems
Projections of geometric models - Orthographic and Perspective projections, Design and Engineering
applications

Unit V CAD Data Exchange
Introduction, CAD Kernels, CAD Data File, Data interoperability, CAD Data Conversions,
challenges in CAD data conversions/remedies, Direct Data Translators, Neutral 3D CAD file formats
(DXF, IGES, PDES, STEP, ACIS, Parasolid, STL, etc.), Data Quality Requirements of CAD file format for 3D Printing (Additive Manufacturing), CAE, FEA, CFD, CAM
(Subtractive Manufacturing), Multi-Body Dynamics (Motion Simulations), Computer Aided
Inspection (CAI), Computer Aided Technologies (CAx), AR/VR applications, etc., Introduction to
CAD Geometry Clean-up for different applications

Unit VI CAD Customization & Automation
Introduction, Limitations of 2D drawings, Introduction to Product and Manufacturing Information
(PMI), Model Based Definitions (MBD), Applications of PMI & MBD
CAD Customization: Introduction, advantages and disadvantages, Applications of Customization
Interfaces, Product Customization Approaches - Part Modeling Customization, Assembly Modeling
Customization, Drawing sheets & PMI Customization, CAD Automation
Introduction to Application Programming Interface (API), Structures of APIs, Coding/Scripting for
customization, Introduction to CAD API Development, CAD Files & application handling

Books & Other Resources

Text Books
1. Zeid, I and Sivasubramania, R., (2009), “CAD/CAM : Theory and Practice”, 2nd edition,
McGraw Hill Education, ISBN-13: 978-0070151345
2. Rao, P. N., (2017), “CAD/CAM: Principles and Applications”, 3rd edition, McGraw Hill

Education, ISBN-13: 978-0070681934
3. Chang, Kuang-Hua, (2015), "e-Design: Computer-Aided Engineering Design", Academic Press, ISBN-13: 978-0123820389

Reference Books

1. Lee, Kunwoo, (1999), "Principles of CAD/CAM/CAE Systems", Pearson/Addison-Wesley, ISBN-13: 978-0201380361
2. Bordegoni, Monica and Rizzi, Caterina, (2011), "Innovation in Product Design: From CAD to Virtual Prototyping", Springer, ISBN-13: 978-1447161875
3. Vukašinovic, Nikola and Duhovnik, Jože, (2019), "Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering", Springer, ISBN-13: 978-3030023980
4. Um, Dugan, (2018), "Solid Modeling and Applications: Rapid Prototyping, CAD and CAE Theory", 2nd edition, Springer, ISBN-13: 978-3319745930
5. Rogers, D. and Adams, J. A., (2017), “Mathematical Elements for Computer Graphics”, 2nd edition, McGraw Hill Education, ISBN-13: 978-0070486775
6. Hearn, D. D. and Baker, M. P., (2013), "Computer Graphics with OpenGL", 4th edition, Pearson Education India, ISBN-13: 978-9332518711
7. Gokhale, N. S., Deshpande, S. S., Bedekar, S. V. and Thite, A. N., (2008), “Practical Finite Element Analysis”, Finite to Infinite, Pune, India, ISBN-13: 978-8190619509
8. Lee Ambrosius, (2015), “AutoCAD® Platform Customization: User Interface, AutoLISP® , VBA, and Beyond”, John Wiley & Sons, Inc., IN, ISBN-13: 978-1118798904

9. Bucalo, Joe and Bucalo, Neil, (2007), “Customizing SolidWorks for Greater Productivity”, Sheet Metal Guy, LLC, ISBN-13: 978-0979566608
10. Ziethen, Dieter R. (2012), “CATIA V5: Macro Programming with Visual Basic Script”, McGraw-Hill Companies, Inc./Carl Hanser Verlag München, ISBN-13: 978-0071800020, ISBN: 978-007180003-7
11. Programming Manuals of Softwares

Engineering Thermodynamics

202043 - Engineering Thermodynamics

Credits 04

Unit I Fundamentals of Thermodynamics

Introduction, Review of basic definitions, Zeroth law of Thermodynamics, Macro and Microscopic Approach, State Postulate, State, Path, Process and Cycles, Point function and Path function, quasi static process, Equilibrium, **Temperature** (concepts, scales, international fixed points and measurement of temperature), Constant volume gas thermometer and constant pressure gas thermometer, mercury in glass thermometer.

First Law of Thermodynamics: Concept of heat and work, Sign convention and its conversion.

First law of thermodynamics, Joules experiments, Equivalence of heat and work. Application of first law to flow and non-flow Processes and Cycles. Steady flow energy equation (SFEE), Applications of SFEE to various devices such as Nozzle, Turbine, Compressors, Boilers etc. PMM-I kind.

Unit II Ideal Gas and Second law of Thermodynamics

Properties and Processes of Ideal Gas: Ideal Gas definition, Gas Laws: Boyle's law, Charle's law, Avagadro's Law, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas Processes- on P-v and T-s diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, Throttling Processes (Open and Closed systems), Calculations of Heat transfer, Work done, Internal Energy.

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Thermal reservoir, Heat Engine, Refrigerator and Heat pump: Schematic representation, Efficiency and Coefficient of Performance (COP), Kelvin-Planck & Clausius Statement of the Second law of Thermodynamics; PMM-II kind, Equivalence of the two statements; Clausius Inequality, Concept of Reversibility and Irreversibility, Carnot Theorem/Principles, Carnot Cycle.

Unit III Entropy and Availability

Entropy: Entropy as a property, Clausius Inequality, Principle of

increase of Entropy Principle,
Entropy changes for an Open and Closed System, Change of Entropy for an ideal gas and Pure
Substance, Concept of Entropy generation. Entropy - a measure of Disorder.

Availability: Available and Unavailable Energy, Concept of Availability, Availability of heat source
at constant temperature and variable temperature, Availability of non-flow and steady-flow Systems.

Unit IV Properties of Pure substances & Thermodynamics of Vapour Cycle

Properties of Pure substances: Formation of steam, Phase changes, Properties of steam, Use of
Steam Tables, Study of P-v, T-s and h-s plots (Mollier Chart) for steam, Dryness fraction and its
determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined) Non-flow
and Steady flow Vapour Processes, Change of Properties, Work and Heat transfer.

Thermodynamics of Vapour Cycle: Rankine Cycle, Comparison of Carnot cycle and Rankine
cycle, Introduction to Steam power Plant, Efficiency of Rankine Cycle, Relative Efficiency, Effect of
Varying operating parameters like Superheat, Boiler and Condenser Pressure on performance of
Rankine cycle, Modified Rankine Cycle.

Unit V Fuels and Combustion

Types of fuels, Proximate and ultimate analysis of fuel, Combustion theory, Combustion Equations,
Theoretical and Excess air requirements, Equivalence ratio, Analysis of products of combustion,
Calorific value - HCV & LCV. Bomb and Boys gas Calorimeters. Flue Gas Analysis using Orsat
Apparatus, Exhaust Gas analyser, Enthalpy of formation, Adiabatic flame temperature.

Unit VI Steam Generators & Boiler Draught

Steam Generators: Classification, Constructional details of low pressure boilers, Primary Features
of high pressure (Power) boilers, Location, Construction and working principle of boiler, Boiler

mountings and accessories, Instrumentations required for safe and efficient operation, Introduction to
IBR Act, Boiler performance Calculations-Equivalent Evaporation, Boiler efficiency, Heat balance
Sheet.
Boiler Draught: Classification, Necessity of Draught, Natural draught, Determination of Height of
chimney, Diameter of chimney, condition for maximum discharge, Forced draught, Induced draught,
Balanced draught, Draught losses.

Books & Other Resources

Text Books
1. P. K. Nag, “Engineering Thermodynamics”, Tata McGraw Hill Publications
2. R. K. Rajput, “Engineering Thermodynamics”, EVSS Thermo, Laxmi Publications
3. P. L Ballaney, “Thermal Engineering”, Khanna Publishers
4. C.P. Arora, “Thermodynamics”, Tata McGraw Hill
5. Domkundwar, Kothandaraman and Domkundwar,“Thermal Engineering”,Dhanpat Rai
Publishers
6. M M Rathore, “Thermal Engineering”, Tata McGraw-Hill
Reference Books
1. Rayner Joel, “Basic Engineering Thermodynamics”, AWL-Addison Wesley
2. Cengel and Boles, “Thermodynamics an Engineering Approach”, McGraw Hill
3. G.VanWylen, R.Sonntag and C.Borgnakke, “Fundamentals of Classical Thermodynamics”, John
Wiley & Sons
4. Holman J.P, “Thermodynamics”, McGraw Hill
5. M Achuthan, “Engineering Thermodynamics”, PHI
6. Steam Tables/Data book

Engineering Materials and Metallurgy

202044 - Engineering Materials and Metallurgy

Credits 04

Unit I Crystal Structures and Deformation of Materials

Crystal Structures: Study of Crystal structures BCC, FCC, HCP and lattice parameters &
properties, Miller indices, Crystal imperfections, and Diffusion Mechanisms
Material Properties: Mechanical (Impact, hardness, etc.), Electrical, optical and Magnetic
properties
Deformation of Materials: Elastic deformation, Plastic deformation: slip, twinning, work
hardening, baushinger effect, recovery, re-crystallization and grain growth, Fracture: Types of
fractures (brittle, ductile), Creep & Fatigue failures

Unit II Material Testing and Characterization Techniques
Destructive Testing: Impact test, Cupping test and Hardness test
Non-Destructive Testing: Eddy current test, Sonic & Ultrasonic testing, X-ray Radiography testing
(Principle and Applications only)
Microscopic Techniques: Sample Preparation and etching procedure, optical microscopy, Electronic
microscopy - only SEM, TEM and X-ray diffraction (Principle and Applications only)
Macroscopy: Sulphur printing, flow line observation, spark test

Unit III Phase Diagrams and Iron-Carbon Diagram
Solid solutions: Introduction, Types, Humerothery rule for substitutional solid solutions
Solidification: Nucleation & crystal growth, solidification of pure metals, solidification of alloys.
Phase Diagrams: Cooling curves, types of phase diagrams, Gibbs phase rules
Iron-Carbon Diagram: Iron-carbon equilibrium diagrams in detail with emphasis in the invariant
reactions

Unit IV Heat Treatments
Austenite transformation in steel: Time temperature transformation diagrams, continuous cooling
transformation diagrams. Retained austenite and its effect
Steps in Heat treatment and Cooling Medium
Heat Treatment Processes: Introduction, Annealing (Full annealing, Process annealing, Spheroidise
annealing, isothermal annealing, stress relief annealing),

Normalising, Hardening, Tempering,
Austempering, Martempering, Sub-Zero Treatment, Hardenability
Surface Hardening: Classification, Flame hardening, Induction hardening, Carburising, Nitriding,
Carbonitriding

Unit V Ferrous Materials
Carbon Steel: Classification, types & their composition, properties and Industrial application
Alloy Steels: Classification of alloy steels & Effect of alloying elements, examples of alloy steels,
(Stainless steel, Tool steel) sensitization of stainless steel
Designation of carbon steel and alloy steels as per IS, AISI, SAE Standards
Cast Iron: Classification, types & their composition, properties and Industrial application of (White
CI, Gray CI, SG CI, Malleable Cast and alloy Cast Iron)
Microstructure and property relationship of various ferrous Materials

Unit VI Non-Ferrous Materials
Classification of Non-Ferrous Metals: Study of Non-ferrous alloys with Designation, Composition,
Microstructure
Mechanical & other properties for Industrial Applications:
Copper and its Alloys (Gilding Metal,
Cartridge Brass, Muntz Metal, Tin Bronze, Beryllium Bronze),
Aluminium and its Alloy (LM5,
Duralumin, Y-Alloy, Hinduminum), Nickel and its Alloys (Invar, Inconel), Titanium and its Alloys
(α Alloys, α-β Alloys), Cobalt and its Alloys (Stellite Alloys, Alnico),
Bearing Alloys
(Classification, lead based alloys, tin based alloys), Age Hardening
Microstructure and Property relationship of various Non-ferrous Materials
Recent Material used in Additive Manufacturing: Properties, Composition and Application only

Books & Other Resources

Text Books
1. Dr. V. D. Kodgire & S. V. Kodgire, “Material Science & Metallurgy For Engineers”, Everest
Publication.

2. William D. Callister, “Materials Science and Engineering an Introduction”, Jr, John Wiley &
Sons, Inc.

Reference Books

1. A. K. Bhargava, C.P. Sharma, “Mechanical Behaviour & Testing of Materials”, P H I Learning
Private Ltd.
2. Raghvan V., “Material Science & Engineering”,Prentice Hall of India, New Delhi. 2003
3. Avner, S.H., “Introduction to Physical Metallurgy”, Tata McGraw-Hill, 1997.
4. Higgins R. A., “Engineering Metallurgy”, Viva books Pvt. Ltd.
5. George Ellwood Dieter, “Mechanical Metallurgy”, McGraw-Hill 1988
6. Smith, W.F, Hashemi, J., and Prakash, R., “Materials Science and Engineering in SI Units”, Tata
McGraw Hill Education Pvt. Ltd.

Electrical and Electronics Engineering

203156 - Electrical and Electronics Engineering

Credits 04

Unit I Introduction to Arduino

Introduction to microcontroller and microprocessors, role of embedded systems, open source
embedded platforms, Introduction to Arduino IDE- features, IDE overview, Programming concepts:
variables, functions, conditional statements, Concept of GPIO in Atmega328 based Arduino board,
digital input and output

Unit II Peripheral Interface

Interfacing of Atmega328 based Arduino board with LED and LCD/serial monitor, serial
communication using Arduino IDE, Concept of ADC in Atmega328 based Arduino board,
interfacing of Atmega328 based Arduino board with temperature sensor (LM35), LVDT, strain
gauge

Unit III DC Machines

Generating and motoring action, Constructional features of a DC

machine, EMF equation of DC
machine and its significance in motor
Concept of torque developed by motor and it's equation, Concept of load torque, Types of loads and
dynamics of motor and load combination, Characteristics of DC shunt motor, Speed control methods
of DC shunt motor, Reversal of direction of rotation of DC motor, Braking in DC motor and its
types, Regenerative braking in DC shunt motor

Unit IV Three Phase Induction Motors
Constructional features, working principle of three phase induction motor, types, torque equation,
torque-slip characteristics, effect of rotor resistance on characteristics, modification in squirrel cage
motor with deep bar rotor construction

Power stages, efficiency, starters (DOL starter and Star Delta starter), Methods of speed control-
voltage and frequency control, variable frequency drive, applications

Unit V Electric Vehicle (EV) Technology
Brief history of Electric Vehicle (EV), Components of EV, Benefits of EV
Types of EVs such as Battery EV, Hybrid EV, Plug-in EV, Fuel Cell EV and their comparison,
Challenges faced by EV technology
Subsystems and configurations of EV, Subsystems of Hybrid EV, Configurations of series, parallel
and series-parallel Hybrid EV
Impact of EV on grid, Vehicle to grid technology- block diagram

Unit VI Energy Storage Devices and Electric Drives
Storage Devices: Cell construction and working of batteries like Lithium- Iron Phosphate (LFP),
Lithium Nickel-Manganese-Cobalt (NMC) and Lithium- Manganese Oxide (LMO), Voltage,
Impedance, Ah and Wh Capacity, Cycle Life, Energy density, Power, C-rate and safety aspects
Use of supercapacitor and hydrogen fuel cell in EVs- necessity, advantages and specifications
Factors used in selection of energy storage device in case of EVs, Vehicle Battery Management
System - block diagram

Electric Drives: Factors used for selection of the electric motor in EVs
BLDC hub motor drive for EVs, characteristics and speed control of BLDC motor, three phase
induction motor drive for EVs

Books & Other Resources

Text Books

1. Barret Steven F, “Arduino Microcontroller Processing for Everyone!”, 3rd Ed, Morgan and
Claypool Publishers
2. Michael Margolis, “Arduino Cookbook”, 2nd Ed, O'Reilly Media
3. Hughes Edward, “Electrical and Electronic Technology”, Pearson Education
4. Ashfaq Husain, “Electric Machines”, 3rd Ed, Dhanpat Rai & Sons
5. Bhattacharya S. K., “Electrical Machine”, 3rd Ed, Tata McGraw Hill
6. Nagrath & Kothari, “Electrical Machines”, Tata McGraw Hill
7. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press
8. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and
Fuel Cell Vehicles: Fundamentals, Theory and Design”, 2nd Ed, CRC Press

Reference Books

1. Deshmukh Ajay, “Microcontrollers Theory and Applications”, Tata McGraw Hill
2. Massimo Banzi, “Getting Started with Arduino”, 2nd Ed, Maker Media, Inc.
3. Brad Kendall, “Getting Started With Arduino: A Beginner's Guide”, Justin Pot and Angela
Alcorn (Editors)
4. Lowe, “Electrical Machines”, Nelson Publications
5. [A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, “Electrical Machines”, 5th Ed, Tata McGraw Hill
6. Pillai S. K., “A First Course on Electrical Drives”, New Age International (P) Ltd.
7. James Larminie, John Lowry, , “Electric Vehicle Technology Explained”, Wiley
8. Dhameja Sandeep, “Electric Vehicle Battery Systems”, Newnes
9. R. Krishnan,“Permanent Magnet Synchronous and Brushless DC Motor Drives”, CRC Press

Mathematics-IV

Subject Code KAS302/KAS402

Mathematics-IV

(PDE, Probability and Statistics)

Module I: Partial Differential Equations

Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order,
Lagrange's Equations, Charpit's method, Cauchy's method of Characteristics, Solution of Linear
Partial Differential Equation of Higher order with constant coefficients, Equations reducible to
linear partial differential equations with constant coefficients.

Module II: Applications of Partial Differential Equations:

Classification of linear partial differential equation of second order, Method of separation of
variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation
in two dimensions, Equations of Transmission lines.

Module III: Statistical Techniques I:

Introduction: Measures of central tendency, Moments, Moment generating function (MGF) ,
Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of
second degree parabola, Exponential curves ,Correlation and Rank correlation, Regression
Analysis: Regression lines of y on x and x on y, regression coefficients, properties of regressions
coefficients and non linear regression.

Module IV: Statistical Techniques II:

Probability and Distribution: Introduction, Addition and multiplication law of probability,
Conditional probability, Baye's theorem, Random variables (Discrete and Continuous Random
variable) Probability mass function and Probability density function, Expectation and variance,
Discrete and Continuous Probability distribution: Binomial, Poission and Normal distributions.

Module V: Statistical Techniques III:
Sampling, Testing of Hypothesis and Statistical Quality Control: Introduction , Sampling
Theory (Small and Large) , Hypothesis, Null hypothesis, Alternative hypothesis, Testing a
Hypothesis, Level of significance, Confidence limits, Test of significance of difference of means,
T-test, F-test and Chi-square test, One way Analysis of Variance (ANOVA).Statistical Quality
Control (SQC) , Control Charts , Control Charts for variables (X and R Charts), Control Charts
for Variables (p, np and C charts).

Text Books
1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley &
Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory,
Universal Book Stall, 2003(Reprint).
3. S. Ross: A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd
Ed., Wiley, 1968.

Reference Books
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
2.T.Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New
Delhi.
3. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa Publishing
House, New Delhi.
4. J.N. Kapur: Mathematical Statistics; S. Chand & Sons Company Limited, New Delhi.
5. D.N.Elhance,V. Elhance & B.M. Aggarwal: Fundamentals of Statistics; Kitab Mahal
Distributers, New Delhi

Manufacturing Process

UNIT-I

Conventional Manufacturing processes:

Casting and moulding: Metal casting processes and equipment, Heat transfer andsolidification, shrinkage, riser design, casting defects and residual stresses.Introduction to bulk and sheet metal forming, plastic deformation and yield criteria;fundamentals of hot and cold working processes; load estimation for bulk forming (forging,rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principlesof powder metallurgy.

UNIT-II

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components:Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes,Introduction to CNC machining.Additive manufacturing: Rapid prototyping and rapid toolingJoining/fastening processes:

Physics of welding, brazing and soldering;design considerationsin welding,Solid and liquid state joining processes;Adhesive bonding.

UNIT-III

Grinding & Super finishing:

Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centreless grinding. Super finishing: Honing, lapping and polishing.

UNIT-IV

Metal Joining (Welding):

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding:

Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic

hydrogen, submerged arc,
electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Weld decay in HAZ.

UNIT-V

Unconventional Machining Processes:
Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, UltrasonicMachining,
principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish,tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining(ECM), etchant &maskant, process parameters, MRR and surface finish.Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron BeamMachining.

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventionaland
unconventional manufacturing methods employed for making different products.

Books and References:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-
Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and
Systems.
3. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
4. Materials and Manufacturing by Paul Degarmo.
5. Manufacturing Processes by Kaushish, PHI.
6. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
7. Production Technology by RK Jain.
8. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.

Sensor and Instrumentation

Unit- I:

Sensors & Transducer: Definition, Classification & selection of

sensors, Measurement of displacement
using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement
of pressure using LVDT based diaphragm & piezoelectric sensor.

Unit-II:

Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging,
Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of
proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level
Sensors: Ultrasonic & Capacitive.

Unit -III:

Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual
Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs,
Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial
automation.

Unit-IV:

Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types of
ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R
Ladder type, Use of Data Sockets for Networked Communication.

Unit V:

Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors:
Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot
control & automobile engine control.

Kinematics of Machinery

Unit I Fundamentals of Mechanism

Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic
pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom, Mobility of
Mechanism, Inversion, Grashoff's law, Four-Bar Chain and its Inversions, Slider crank Chain and
its Inversions, Double slider crank Chain and its Conversions,

Mechanisms with Higher pairs,
Equivalent Linkages and its Cases - Sliding Pairs in Place of Turning Pairs, Spring in Place of
Turning Pairs, Cam Pair in Place of Turning Pairs

Unit II Kinematic Analysis of Mechanisms: Analytical Method

Analytical methods for displacement, velocity and acceleration analysis of slider crank Mechanism,
Velocity and acceleration analysis of Four-Bar and Slider crank mechanisms using Vector and
Complex Algebra Methods. Computer-aided Kinematic Analysis of Mechanism like Slider crank and
Four-Bar mechanism, Analysis of Single and Double Hook's joint

Unit III Kinematic Analysis of Mechanisms: Graphical Method

Displacement, velocity and acceleration analysis mechanisms by Relative Velocity Method
(Mechanisms up to 6 Links), Instantaneous Centre of Velocity, Kennedy's Theorem, Angular
Velocity ratio Theorem, Analysis of mechanism by ICR method (Mechanisms up to 6 Links),
Coriolis component of Acceleration (Theoretical treatment only)

Unit IV Synthesis of Mechanisms

Steps in Synthesis: Type synthesis, Number Synthesis, Dimensional synthesis, Tasks of Kinematic
synthesis - Path, function and motion generation (Body guidance), Precision Positions, Chebychev
spacing, Mechanical and structural errors
Graphical Synthesis: Inversion and relative pole method for three position synthesis of Four-Bar
and Single Slider Crank Mechanisms
Analytical Synthesis: Three position synthesis of Four-Bar mechanism using Freudenstein's
equation, Blotch synthesis

Unit V Kinematics of Gears

Gear: Classification
Spur Gear: Terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of
contact, sliding velocity, Interference and undercutting, Minimum number of teeth to avoid
interference, Force Analysis (theoretical treatment only)
Helical and Spiral Gears: Terminology, Geometrical Relationships, virtual number of teeth for
helical gears

Bevel Gear & Worm and Worm Wheel: Terminology, Geometrical Relationships
Gear Train: Types, Analysis of Epicyclic gear Trains, Holding torque - simple, compound and
Epicyclic gear Trains, Torque on Sun and Planetary gear Train, compound Epicyclic gear Train

Unit VI Mechanisms in Automation Systems

Cams & Followers: Introduction, Classification of Followers and Cams, Terminology of Cam
Displacement diagram for the Motion of follower as Uniform velocity, Simple Harmonic Motion
(SHM), Uniform Acceleration and Retardation Motion (UARM), Cycloid motion, Cam Profile
construction for Knife-edge Follower and Roller Follower, Cam jump Phenomenon
Automation: Introductions, Types of Automation
Method of Work Part Transport: Continuous transfer, Intermittent or Synchronous Transfer,
Asynchronous transfer, Different type of transfer mechanisms - Linear transfer mechanisms and
Rotary transfer mechanisms
Automated Assembly-Line: Types, Assembly line balancing Buffer Storages, Automated assembly
line for car manufacturing, Artificial intelligence in automation